New South Wales Mussels

A Taxonomic Review of the Family Mytilidae from the Peronian Zoogeographical Province

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(Figs. 1-53.)

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INTRODUCTION.

This is one of a series of papers, a number of which have already appeared, in which single families of molluscs from the Peronian Zoogeographical Province are reviewed taxonomically as a whole. The object is to bring the widely scattered references into one paper, and to illustrate and discuss all the species and subspecies and their relationship one with another. The description of new species or genera is secondary, though this inevitably has been found necessary to a greater or less extent.

The mussels as a whole play an important part in the marine ecology of the Australian coast, particularly of the foreshore, and their place in the intertidal zonation has been studied by Bennett and Pope (1953). Though their spawning habits have not been specially studied, it is obvious from their gregarious habit, and by inference from the known spawning habits of other pelecypods, that they must be extremely prolific. The littoral species are therefore well fitted to take advantage of any means of migration, and as inhabitants of the intertidal zone they are also well adapted to withstand considerable ranges in temperature. As a result many species so placed have a range throughout more than one zoogeographical province, though there is generally a greater local concentration to make a species more characteristic of one province than another. The range on the whole is wider than in many other families of mollusca. The wider range may also be accounted for by antiquity. The family goes far back in geological history, though the true phylogenetics of fossil forms are imperfectly understood. In Australia some forms have been described from the Permian; then there is a great time-gap to the Cretaceous, the next period from which extensive marine deposits are known. Many mussels have been found in the Australian Cretaceous, but have never been worked out, and much of the material is in poor condition. In the Australian Tertiary there are some links between fossils and species now living on the continental shelf, but less between fossils and recent littoral forms. This can be understood, as the bulk of the Tertiary deposits are from deeper water, and fossils from the littoral zone can be expected only from restricted areas on the border of the Tertiary Sea. These may yet be found, probably from the vicinity of the lower Darling River and parts of the Murray River Valley.

The family Mytilidae is fairly well defined, though some modern conchologists advocate a division into two famliies, Mytilidae and Modiolidae. The division is based largely on the hinge, Mytilidae having hinge teeth while the Modiolidae are edentulous. This character alone hardly seems sufficient, for when teeth are present they are small and rarely functional, appearing more as a development and modification of crenulations on the dorsal margin. Only in *Austromytilus* do they appear immediately below the umbos on what is approximately a true hinge plate, but even here they are irregular in size and number and tend to become obsolete on maturity. There is no resemblance to the definite pattern and interlocking of the hinges of most of the higher families of pelecypods, nor even to that of the more primitive taxodonts. In the description of species which follows, the term "teeth" is used where they are functional, that is interlocking with those of the opposite valve; otherwise the term "pseudo-teeth" is used.

Hedley (1917) listed 18 species of Mytilidae from the Peronian Province. Subsequently Iredale in various papers rejected one species, renamed others and added a new record. In this paper 22 species are discussed and figured, some further revision of nomenclature has been undertaken, necessitating the proposal of one generic and 5 new specific names, and the addition of 2 new records from the Province. Original descriptions have been amplified, taxonomic comparison has been made, and some new data added on the distribution of the various species.

All types, paratypes and specimens illustrated have been presented to the Australian Museum, Sydney.

The following is now the complete list of Peronion species.

Mytilus planulatus Lamarck.
Austromytilus rostratus (Dunker).
Septifer australis, sp. nov.
Trichomya hirsuta (Lamarck).
Musculus cumingianus (Reeve).
Musculus ulmus Iredale.
Musculus alganus, sp. nov.
Musculus varicosus (Gould).
Trichomusculus barbatus (Reeve).
Trichomusculus splendidus (Dunker).
Modiolus peronianus, sp. nov.
Modiolus cottoni, sp. nov.
Modiolus agripeta Iredale.
Modiolus victoriae Pritchard & Gatliff.
Modiolus delinificus Iredale.
Modiolus pulex (Lamarck).
Amygdalum beddomei Iredale.
Amygdalum lineum (Hedley).
Amygdalum glaberrimum (Dunker).
Fluviolanatus amarus sp. nov.
Exosiperna relata Iredale.
Solamen rex Iredale.

DESCRIPTION OF SPECIES.

Genus MYTILUS Linne.

Syst. Nat., ed. 10, 1758, p. 704. Type species *Mytilus edulis* Linne.

Mytilus is now restricted to mussels with a few small hinge teeth on a thickened marginal extension anterior to the umbos. The teeth are functional, interlocking with those of the opposite valve. The shell is wedge-shaped, very inequilateral, the umbos anteriorly terminal and acute, sculpture smooth or finely concentric, periostracum smooth, byssus strong, ligament linear, set in a marginal groove.

Mytilis planulatus Lamarck.
(Figs. 1-3.)

Mytilus planulatus Lamarck, 1819, Anim. sans Vert., 6, p. 125.

The type locality is Western Australia, and the species ranges throughout southern Australia to the east coast. In New South Wales it is one of the commonest species, forming dense, gregarious colonies on piles and rocks in the outer harbours just below the limit of low tide level. The form is variable, Western Australian specimens being generally broader than those from the east, though among the latter are many individuals which are just as broad. The colour varies from deep brown to nearly black, with a strong violet tinge particularly noticeable on worn specimens. The interior is white, except at the margins. The small teeth are variable in number, generally 3 in each valve, but there may be 5 or 6. They are best seen in young specimens, and in many mature shells they are quite obsolete. The specimen illustrated is from North Harbour, Port Jackson, its height from the umbo to the extreme posterior-ventral margin 59 mm., the depth of the conjoined valves 23 mm.

Genus AUSTROMYTILUS, gen. nov.

Type-species *Mytilus rostratus* Dunker.

A genus of the Mytilidae characterised by a few, prominent nodular hinge-teeth set on a plate immediately below the umbo, a black, smooth periostracum, radial sculpture, a semi-internal ligament set in a groove behind the umbo. The number of teeth is variable, even in the one species, but the general formula is 2 in the left valve and one in the right. The form of the shell is very inequilateral, and the umbos are terminal and rostrate. The adductor muscles are unequal, the posterior large, rounded ventrally and elongated dorsally, the anterior small, round and deeply excavated just below the hinge plate. The habit is gregarious, individuals adhering by a hirsute byssus protruding from between the valves just below the umbo.

By its shell characters *Austromytilus* is related to the true *Mytilus*, but differs by its radial sculpture, and by the large irregular teeth below the umbo. In *Mytilus* the teeth are small and set on an anterior extension of the margin. In *Brachyodontes*, to which the type has been referred, there are no cardinal teeth, but a row of small pseudo-teeth on the margin above the ligamental groove posterior to the umbo. The southern and western species *M. erosus* (Lamarck) has a hinge much nearer to this type.

Austromytilus rostratus (Dunker).

(Figs. 4, 5.)

Mytilus rostratus Dunker, 1857, Proc. Zool. Soc. Lond., 1856, p. 538; Reeve, Conch. Icon., 1857, 10, pl. 5, fig. 15.

The type locality is Tasmania, and the species is very common in communal masses in the intertidal zone throughout southern Australia. In the east it has invaded the Peronian Province and is found in occasional patches as far north as Jervis Bay, but is never common. The specimen figured is from Narooma, its height 33 mm. and depth of conjoined valves 15 mm.

In the past there has been some doubt as to whether it was a variation of *Mytilus erosus* Lamarck, but good figures by May (1923) and Cotton and Godfrey (1938) make the differences clear. The only other possible doubt was whether Lamarck's original *erosus* was not really the rostrate form, as his quite inadequate description indeed suggested. The type of *erosus* is in the Paris Museum and has never been figured, so drawings of the two species were sent to Paris for comparison. Fortunately this showed that the interpretations by later Australian authors were correct, and the identification of the two species can be considered as satisfactorily settled.

A. rosratus is variable in shape and when in dense colonies is often deformed, and the upper portion of both valves much eroded, but when growing singly it is generally wider and constant. The teeth are stronger in young shells, and in very old individuals they may be fused together or often nearly obsolete. They are irregular in form. Generally there are 2 in the left valve and 1 in the right, but the formula may vary as 1-0, 2-1, 3-2, 2-3 and even 4-3. These teeth are true teeth, interlocking with those of the opposite valve. The colour of eroded specimens is generally purple, but when uneroded is nearly black.

Genus SEPTIFER Recluz.

Septifer Recluz, 1848, Rev. Zool., p. 275. Type species *Mytilus bilocularis* Linne.

The shell is trigonal and very inequilateral, the umbos terminal, the sculpture of radial ribs on the posterior portion. The main generic character is, however, the subumbonal shelf in which is excavated an impression for the insertion of the anterior muscle. The distribution of the genus is given as from Mauritius to Australia. It is generally associated with coral reefs, and most of the described species are tropical. Iredale records two species from Queensland, doubtfully referred to *S. bilocularis* and *S. excisa* Wieg-

mann. Again from New Zealand Powell* records from the stomach of a fish a single valve which he compares with *S. bilocularis*, and also remarks that similar valves are not uncommon in a dredging from 10-30 metres off the Kermadecs. A species occasionally found in New South Wales has been variously determined as *bilocularis* and *S. kraussi* Kust, and it is here named as new.

The genus is also found in the Victorian Tertiary, and it is probable that the New South Wales and New Zealand forms have more relationship with the fossil than with living species.

Septifer australis, sp. nov.

(Figs. 6, 7.)

Shell small, solid, trigonal, narrow anteriorly, expanded posteriorly, very inequilateral, the umbo large and terminal with a small, round prodissoconch. Dorsal margin straight, ventral margin sinuate, posterior margin rounded. Colour white flecked with brown. Sculpture of concentric growth furrows, crossed on the posterior portion by numerous, well defined, radiating ridges. Hinge line long and straight, with a wide, strong ligamental grooved plate behind the umbo. The margin above this and also the anterior margin are crenulate. Below the umbo is a wide, definite plate, deeply excavated for the anterior adductor muscle. Above this on the left valve are two small, deep impressions. Posterior adductor scar very faintly impressed. Height from umbo obliquely to posterior-ventral margin 5.4 mm., depth of a single valve approximately 1.6 mm.; the corresponding measurements of the paratype 6.4 mm. and approximately 2.4 mm.

Locality.—14 fms. off Long Reef, holotype and 1 paratype.

Remarks.—This is probably the species previously recorded from New South Wales as *S. bilocularis* Linne, the type of which came from Mauritius. It differs, however, radically in shape and sculpture from that species, and also from the Victorian Tertiary fossil *S. fenestratus* Tate.

Genus TRICHOMYA Ihering.

Trichomya Ihering, 1900, Proc. Mal. Soc. Lond., 4, p. 87, Type-species *Mytilus hirsutus* Lamarck.

The nomenclature was reviewed by Iredale (1924). Later (1939) he proposed a further genus *Dentimodiolus* with a new Queensland species *sculptus* as type. From Iredale's description of the hinge of *Dentimodiolus* there seems very little difference between *Trichomya* and *Dentimodiolus*. It reads: "ligament set upon a shallow shelf, above which the margin is strongly numerously toothed; teeth as round knobs, not interlocking with opposite series; the pseudo-teeth continuing all along the upper margin, but disappearing ventrally, stronger at the anterior end where they may act as true teeth." This description applies equally well to *hirsutus*, the type of *Trichomya*, except that in *hirsutus* there is individual variation in the hinge. For instance, in some specimens the anterior marginal crenulations below the umbo are faint, in others the uppermost 2 or 3 are quite large and rounded and simulate true teeth. Cotton and Godfrey (1938) placed the three species *rostratus*, *erosus* and *hirsutus* all under *Brachyodontes*, but here they are considered as generically separate, not only from *Brachyodontes* but from each other. An obvious conchological difference apart from the hinge between *hirsutus* and the other two is that it possesses a hirsute periostracum, the hairs of which are forked as in *Trichomusculus*.

Another character noticed by Iredale (1924) suggests relationship between *Trichomya* and *Trichomusculus* and *Musculus*: this is the sculpture. Though the sculpture of *Trichomya hirsuta* is primarily radial and at first sight appears to cover the whole shell equally, close examination shows that in the sinus on the ventral margin at the anterior end it becomes very faint or even quite obsolete, reappearing again just below the umbos.

* Rec. Auck. Mus., 1954, 4, p. 235.

Trichomya hirsuta (Lamarck).

(Figs. 8-10.)

Mytilus hirsutus Lamarck, 1819, Anim. sans vert., 6, p. 120.

The type locality is doubtful, but may be South Australia. Fortunately it is a well defined species and its identity is well established. In New South Wales it is very abundant in the bays where it grows in gregarious masses and forms a well defined band in the lower part of the littoral zone. It prefers a truly marine environment, and in the upper reaches of Port Jackson and in the river estuaries it is generally replaced by *Modiolus pulex*. Owing to crowding the form is often distorted, and it varies accordingly much in shape. The masses of individuals bound together by the hirsute periostracum provide shelter for many other organisms and constitute a distinct ecological unit. It can be readily recognised by its form, brown coloration and pearly interior. The specimen illustrated came from Port Jackson; its height from umbo to extreme posterior ventral extremity is 59 mm. and depth of conjoined valves 32 mm. It has also been recorded from Tasmania and Victoria, where it is rare, and from South Australia where it is quite common. It is also common in large colonies in southern Queensland, and specimens from Hervey Bay within the Solanderian Province cannot be separated from those from New South Wales.

Genus MUSCULUS Bolten.

Musculus Bolten, 1798, Mus. Bolt., p. 156. Type species *Musculus discors* Linne.

Iredale (1924 & 1936) has outlined the nomenclature of this genus, which may be accepted for a group of Australian shells with smooth periostraca, edentulous hinges, marginal ligaments and discrepant, threefold sculpture, radial sculpture occurring at both the anterior and posterior ends with a central area smooth except for faint concentric growth lines. A further subdivision by Iredale (1924) placed those species with otherwise similar characters but with hirsute periostraca in a new genus *Trichomusculus*.

Cotton and Godfrey (1938) have not accepted *Trichomusculus*, but in their key to the South Australian species of *Musculus* use the nature of the periostracum as a primary subdivision.

Living species of both these groups seem to be direct descendants of Tertiary fossils from southern Australia. For instance *Musculus cumingianus* greatly resembles *Modiolaria corioensis* Tate from the Miocene of Corio Bay, Victoria, and *Trichomusculus barbatus* is close to *Modiolaria semigranosa* Tate from the Adelaide bore.

Musculus cumingianus (Reeve).

(Fig. 11.)

Modiola cumingianus Reeve, 1857, Conch. Icon., 10, pl. 9, fig. 50.

The validity of this name is still in doubt, depending on whether it is a distinct species from the South Australian *M. nanus* Dunker. If not the latter name has a year's priority. The type locality of *cumingianus* is Moreton Bay, Queensland, and the species ranges right down the New South Wales coast, generally attached to ascidians or sponges. The specimen figured came from Long Reef, near Sydney; its length is 24 mm., height 15 mm. and depth of conjoined valves 13.5 mm. An important character for specific determination is the number and disposition of the radial ribs. In the New South Wales specimens the anterior ribs are always the most prominent; they are narrow and well raised with wide, flat channels between, and number 7-8, of which the 3-4 commencing on the umbo stand out, while the others at the extreme anterior end are faint. The posterior ribs are less defined and number approximately from 20-24. The colour is generally a rich red brown. The South Australian *nanus* Dunker and the New Zealand *impactus* Hermann, if not identical, are both very close to this. The species

cuneatus Gould, which appears on Hedley's Check List (1917), was described from False Bay, Cape of Good Hope, and has among other differences a much greater number of radiating ribs than any Australian species. It has already been rejected from the New South Wales list by Iredale (1936).

Musculus ulmus Iredale.

(Fig. 12.)

Musculus ulmus Iredale, 1936, p. 271, pl. 21, fig. 10.

Small specimens from Port Jackson, which might be taken as immature *cumingianus* were separated chiefly by the greater number of radiating ribs at the anterior end, 15 being counted on the type. The colour generally is green, the same as in some immature specimens of *cumingianus*, but apart from the number of ribs, *ulmus* is even more inequilateral, the umbos overhanging the anterior margin. The specimen figured is from Port Jackson, its length 11 mm., height 6 mm. and depth of conjoined valves 6 mm.

Musculus alganus, sp. nov.

(Figs. 13, 14.)

Shell small, oval in contour, widening at the posterior end, the ventral margin sulcate beneath the umbos, very inequilateral, the umbos tumid and overhanging the anterior end. Colour white to pale yellow, variegated with irregular brown patches. Periostracum thin with a minute granular texture. Sculpture distinctive, 3 or not more than 4 short, radial ribs at the extreme anterior end, the median region smooth except for concentric growth lines, the posterior region with very faint, distant radial threads, often hardly discernible. Hinge edentulous, ligament short, marginal, set in a very narrow submarginal groove. Length 4 mm., depth of conjoined valves 1.9 mm.

Habitat.—Living on algae in rock pools, Yamba, holotype and 1 paratype; also in similar habitat at Point Halliday, common. A series in the Australian Museum from Port Jackson is slightly larger than the type.

Remarks.—It was thought that this might be the juvenile of one of the other species, but the distinctive shape and sculpture and also the uniform size and colouring of series from several localities led to the conclusion that it is quite different. It is not uncommon on the outer beaches, but wave rolled specimens are hard to recognise, and can easily be confused with *M. varicosus*.

Musculus varicosus (Gould).

(Fig. 15.)

Modiola varicosa Gould, Proc. Boston Soc. Nat. Hist., 1861, 8, p. 37.

Though no figure was originally published there is fortunately no doubt as to the identity of the species, as the type-locality is Sydney. It is common on the beaches both within Port Jackson and on the neighbouring coast and also in dredgings from a sandy bottom, but is rarely seen with both valves conjoined. It is readily recognised by the wedge-shaped contour, and by its very narrow anterior end. The colour is variegated, a white to yellow ground with irregular lines, often zigzag, and patches of deep chocolate. It is small, the specimen figured from Port Hacking being about the maximum size. Its length is 13.5 mm. and the depth of the single valve approximately 3.5 mm. The ligament is very weak, the submarginal groove barely discernible on the dorsal margin of the very thin shell.

Genus TRICHOMUSCULUS Iredale.

Trichomusculus Iredale, 1924, Proc. Linn. Soc. N. S. Wales, 49, p. 196. Type-species *Lithodomus barbatus* Reeve.

Hinge and sculpture similar to *Musculus*, but with a hirsute periostracum on the posterior half. It may be noted that the hairs of the periostracum are branched.

Trichomusculus barbatus (Reeve).
(Figs. 16-18).

Lithodomus barbatus Reeve, 1858, Conch. Icon., 10, pl. 5, fig. 27.

The type-locality is given as Port Jackson, 6 fms., in mud. It is a small, well defined species, common on the rocky foreshores of Port Jackson and on the neighbouring coast. It has also been recorded from Tasmania and South Australia. The specimen figured is from North Harbour, Port Jackson; its height obliquely from the umbo to the extreme posterio-ventral margin is 7.5 mm., the depth of the conjoined valves 4.5 mm. Apart from its form it can be readily recognised by the dense, hirsute periostracum covering the posterior portion of the shell and projecting behind in a beard-like appendage. The hairs of the periostracum are long, and often much branched.

Trichomusculus splendidus (Dunker).

(Figs. 19-21.)

Volsella splendida Dunker, 1857, Proc. Zool. Soc. Lond., 1856, p. 365.

Lithodomus splendidus Reeve, 1858, Conch. Icon., 10, pl. 5, fig. 21.

The identity of this species is not yet certain. The type-locality was given by Dunker as California, though it has not since been recognised from there. Reeve figured it as from Sydney. Hedley (1901) provided another figure of the interior only of the local shell. In view of the uncertainty and of the inadequacy of Dunker's original description his name might well be rejected as indeterminable, but it has been difficult to obtain satisfactory material for adequate description, and for this reason no change is proposed in the present nomenclature. Apparently it is rather a rare shell. The specimen illustrated has been identified from Hedley's figure, and came from Kurnell, Botany Bay. Its length is 15 mm., height 6.5 mm. and the depth of the single valve approximately 4 mm. Other specimens came from Huskisson and from the beaches at the mouth of the Clarence River, but the periostracum is so dense, often covering the whole shell, that both the form and sculpture are obscured and identification is difficult. Compared with *barbatus* the form of the shell is more elongated, the dorsal and ventral margins are nearly parallel, and the umbo is more terminal, quite over-hanging the anterior end. The interior anterior margin below the umbo is often deeply crenulated, simulating a row of teeth.

Genus MODIOLUS Lamarck.

Modiolus Lamarck, 1799, Mem. Soc. Nat. Hist. Paris, p. 87. Type-species *Mytilus modiolus* Linne.

The main characteristics of this genus are the very inequilateral, oblique shell, narrow anteriorly but expanding posteriorly, the nearly terminal umbos and the thin, edentulous hingeline. The ligament is internal, set in a long groove excavated in the margin behind the umbos. The sculpture consists of fine growth-lines only, and there is often a hirsute periostracum. Iredale (1939) suggests that when the animals are critically examined the genus may have to be divided into more than one. Superficially he recognises two sections, those with a long hingeline and weak slender ligament and those with a short hingeline and strong ligament. He also notes that members of the former group are mud living and unattached by a byssus, and are also not hirsute, while the latter are attached to rocks, etc., by a byssus and are very hirsute. The division is, however, not as clear cut as this, for at least one species attached by a byssus, *Modiolus pulex*, has a smooth and not a hirsute periostracum.

Modiolus peronianus, sp. nov.
(Figs. 22-24.)

Shell of medium size, stout, very oblique, narrow at the anterior end, dorsal margin arched, about half the total length, posterior end elongated and expanded, angled at its junction with the hinge, ventral margin sinuate, umbos large and prominent, close to the anterior margin which is slightly auriculate.

Colour deep red-brown to almost black, interior purple, worn beach specimens often red. Sculpture of closely spaced, strong, concentric growth-ridges. Periostracum hirsute, covering most of the shell, the hairs not bifurcate but generally bearing short hooks. Hingeline long, arched, edentulous, the ligament internal, behind the umbos, strong, set in a well defined submarginal groove. Adductor muscle scars shallow and not clearly defined. Height from umbo to extreme posterio-ventral margin 57 mm., depth of conjoined valves 28 mm.

Locality.—Gunnamatta Bay, Port Hacking, on sand flats at low tide; holotype and 1 paratype.

Remarks.—This is one of the species previously called *M. australis* Gray, and later identified by Hedley with the New Zealand species *M. areolatus* Gould. *M. australis* was proposed as long ago as 1826, and appeared in all check-lists up to 1923, having at one time or another been applied to several different species. Hedley (1923) finally pointed out that Gray's description was confined to a few remarks about a single worn and unlocalised valve, and decided to discard it as unintelligible. Unfortunately in its place he proposed to use *M. areolatus*, a well defined New Zealand species which very doubtfully occurs in Australia at all. Since then *areolatus* has been applied to more than one Australian species, and the confusion has been perpetuated. For instance, Cotton and Godfrey (1938) used it for a South Australian species, but at the same time stated: "We are not altogether satisfied with the species name *areolatus*," and noted also that Tate wrote of the same species: "*M. australis* Gray, this is also *albicosta* var. *spatula* Lamarck."

Of the Australian species, *peronianus* approaches closest to the New Zealand *areolatus*, but is only half the size, and differs slightly in shape, being even narrower anteriorly and more elongate posteriorly. It is felt that by giving a new name to this Peronian species its identity will be established and future confusion avoided.

Modiolus cottoni, sp. nov.

(Figs. 25-28.)

Shell large, thin, very oblique, very narrow at the anterior end, expanded posteriorly, dorsal margin nearly straight, angled with the posterior margin which is regularly curved, ventral margin sulcate just below the umbo, anterior margin small and auriculate, umbos not large, near the anterior margin. Colour pale yellow brown, one half-grown specimen red, interior pure white. The type has only traces of a periostracum, but if the identification of a group of half grown specimens is correct, it is hirsute, the hairs near the posterior margin being long, thin, flattened and not forked. Hingeline long and nearly straight, edentulous, the ligament internal, thin and weak, set in a very narrow submarginal groove. Adductor muscle scars hardly impressed, the anterior small and close to the umbo, the posterior larger, rather wide, close to the posterior extremity. Depth from umbo to posterior ventral extremity 83 mm., length of hingeline 51 mm., depth of conjoined valves 45 mm.

Locality.—30-50 fms., off Twofold Bay; holotype (Mr. T. A. Garrard).

Remarks.—This appears to be the species known in South Australia as *M. areolatus*, and it cannot be separated from the eastern Tasmanian shell also known by that name. For reasons given when discussing *M. peronianus*, *areolatus* is now discarded for Australian shells. Compared with *M. peronianus* it is a larger, frailer shell with a different contour, even narrower anteriorly, the hingeline is straighter and the ligament much weaker. The colour is also different. For the South Australian species the range in depth is given by Cotton as from below low tide down to 300 fms.

The species is named in honour of Mr. B. C. Cotton whose monumental work in collaboration with Mr. F. K. Godfrey on the South Australian Pelecypoda has been of such assistance to Australian conchologists.

Modiolus agripeta Iredale.

(Figs. 29, 30.)

Modiolus agripeta Iredale, 1939, Gt. Barr. Reef. Exped. Sci. Rept., 5, p. 412, pl. 6, fig. 21.

The type locality is Low Islands, Queensland, where it is gregarious, forming a mat. Several specimens found on the beach at Woolgoolga now add a species to the Peronian fauna, though with other species from this locality it can be looked upon as a migrant from the tropics, its passage assisted by the warm Notonectian Current. The Woolgoolga specimens match the type almost exactly, but owing to their beach-rolled condition most of the very hirsute periostracum has been worn off. The colour is very deep red-brown to chocolate, with a light band extending from the umbo to the ventral margin. The height from the umbo to the ventral margin, the greatest dimension, is 40 mm., the depth of the conjoined valves 25 mm.

Modiolus victoriae Pritchard and Gatliff.

(Figs. 31, 32.)

Modiolus victoriae Pritchard & Gatliff, 1903, Proc. R. Soc. Vict., 16, p. 93, pl. 15, figs. 1, 2; Iredale, 1924, Proc. Linn. Soc. N. S. Wales 49, p. 197.

The type-locality is from 6 fms. off Rhyll, Western Port, Victoria, and Iredale first recorded it from the Peronian Province from shallow water in Twofold Bay. It is obviously a migrant from the Maugean Province, though so far it has not been recorded from Tasmania. The specimen illustrated is from the type-locality, Western Port; its height from the umbo diagonally to the opposite ventral margin is 14 mm., its length 17 mm. and depth of conjoined valves 8 mm. It can readily be distinguished from all other species of *Modiolus* by its much wider anterior end with the dorsal and ventral margins nearly parallel.

Modiolus delinificus Iredale.

(Figs. 33-35.)

Modiolus delinificus Iredale,, 1924, Proc. Linn. Soc. N. S. Wales, 49, p. 196, nom. nov. for *Mytilus albicostus* Lamarck.

The only reason Iredale gives for the rejection of *albicostus* is: "There is a serious doubt as to the validity of this name." Without access to the full literature, and acting on the assumption that Iredale had adequate reasons for his conclusions, *delinificus* is accepted, as the legal term has it, "without prejudice," though it must be noted that Cotton and Godfrey (1938) still retain *albicostus* for the South Australian shell. The type chosen for *delinificus* is that figured by May (1923, pl. 4, fig. 6) and mentioned as common on many ocean beaches in Tasmania. Whatever name is used there can be no doubt of the species referred to. The range is throughout Tasmania and southern Australia as far as Western Australia, and the species seems very constant throughout. In New South Wales it is confined to the extreme south where it is sometimes procured in dredgings. The specimen illustrated was trawled off Brush Island, Bateman's Bay, and this so far is its most northern record. Its height from the umbo to the extreme posterior ventral margin is 70 mm., and the depth of the conjoined valves 33. Another specimen from Twofold Bay is still larger, the corresponding measurements being 84 mm. and 32 mm.

It is easily recognised, the strong ventral sulcus, the broad, inflated posterior ventral carina, and the elongation of the shell in this direction giving it a distinct facies. The colour varies from bright chestnut to deep red-brown, and the umbo and carina are generally white. A series of small shells from 25-30 fms., Twofold Bay, are probably the juveniles of this species, and one of them (fig. 35) is here figured for reference. Its height is 7 mm.

Modiolus pulex Lamarck.
(Figs. 36-38.)

Modiolus pulex, Lamarck, 1819, Anim. sans vert., 6, p. 112.
Perna confusa Angas, 1871, Proc. Zool. Soc., 1871, p. 21, pl. 1, fig. 33.

Though *confusus* has been generally used for the Peronian shell, most recent authors, including Cotton and Godfrey (1938), are satisfied it is a synonym of the southern and western species *pulex*. Hedley in his check-list (1919) used *confusus*, and May (1923) admitted both species, *pulex* for those living on the outer foreshores, and *confusus* for those in the estuaries. In their work on the ecology of Victoria Bennet and Pope (1953) recognise *pulex* as occupying a narrow, well defined band in the upper littoral zone on the outer rocks, and where conditions are favourable, as in western Victoria and South Australia, it occurs in dense masses matted together by the hairy byssus. Individuals are on the whole smaller and rather narrower than those from the estuaries, and in this form are characteristic of the Maugean cool-temperate Province. In New South Wales the species is largely confined to the heads of the bays and to the river estuaries, and in the latter habitat is found well away from the sea in water that is often only brackish. In Port Jackson in the narrow upper reaches of the long inlets such as Lane Cove it is found in communal masses adhering to piles and rocks, where it replaces *Trichomya hirsutus*, found in similar situations nearer the open sea. Fallen logs in the mangroves are another favourite habitat. New South Wales specimens approximate very closely both in form and size to those from South Australia, particularly those living under pure marine conditions as at Shark Island in Port Jackson. The range in New South Wales is wide, from the extreme north coast to the Victorian border, whence it ranges to Bass Strait.

The type locality of *pulex* is King George's Sound, Western Australia, that of *confusus*, Queenscliff Lagoon, just north of Port Jackson. The opinion is here expressed, confirming that of Godfrey and Cotton, that both are the one species, and that slight differences between estuarine and marine forms are not constant, being due to different conditions and are not even racial.

In New South Wales there is considerable variation even in the one location. The length of mature individuals varies from about 15 mm. to a maximum of 25 mm. (Shark Island, Port Jackson), and the colour varies from a deep red-brown to a more common quite black. The shape also varies, and some specimens have the ventral margin deeply sulcate (fig. 36), while others have this margin nearly straight (fig. 38). Fig. 36 shows one from Queenscliff Lagoon; its height from the umbo diagonally to the extreme posterio-ventral margin is 17 mm., the depth of the conjoined valves 8 mm. Fig. 38 is from mangrove swamps at Huskisson, its corresponding measurements 16 mm. and 7.5 mm. respectively.

Genus AMYGDALUM Muhlfeldt.

Amygdalum Muhlfeldt, 1811, Ges. Nat. Fr. Berlin Mag., 5 p. 69. Type species *Mytilus arborescens* Chemnitz, syn. *Amygdalum dentriticum* Muhlfeldt.

Shell like *Modiolus*, very inequilateral with terminal umbos, but narrow and more elongated, the conjoined valves more or less cylindrical, the surface smooth, the texture very thin and translucent. The ligament is very narrow and weak, the hinge edentulous. It often forms a nest from its long byssal threads. *Amygdalum* has been generally neglected by most writers who placed the type species under *Modiolus*, but the name was revived by Iredale (1924).

Amygdalum beddomei Iredale.
(Figs. 39-41.)

Amygdalum beddomei Iredale, 1924, Proc. Linn. Soc. N. S. Wales 49, p. 197, pl. 35, fig. 21.

This is the species previously known to local conchologists as *Modiolus arborescens*, the type of which is said to have come from the island of St. Domingo. The rather involved nomenclature has been reviewed by Iredale,

and apparently there are several species, the Western Australian form being different, while still another occurs in the Moluccas. Specimens from Tasmania cannot be distinguished from those from New South Wales, and South Australian specimens are also similar, though that figured by Cotton and Godfrey (1938) is slightly broader at the anterior end. The specimen here figured is from 30-35 fms. off Crookhaven; its height from the umbo to the extreme posterior ventral margin is 34 mm., the depth of the conjoined valves 9 mm.

It is an inhabitant of the continental shelf, though specimens have been found in Quarantine Bay, Port Jackson, at a depth of 8 fms. This seems to be its most northerly record. It can be easily recognised, not only by the form, but by the brown variegated markings on the posterior end.

Some small, colourless shells up to 5 mm. in length have been collected from various localities on the continental shelf which are probably the young of this species, though they are relatively broader in proportion to their length. One of these from 20-25 fms. off Crookhaven (fig. 41) is here figured for comparison.

Amygdalum lineum (Hedley).

(Figs. 42, 43 (after Hedley).)

Modiolus lineus Hedley, 1906, Rec. Aust. Mus., 6, p. 300, pl. 56, figs. 23-25.

The type-locality is 80 fms. off Narrabeen, and the species has also been recorded from deep water in Tasmania and South Australia. The dimensions given by Hedley are length 5.75 mm., height 2.5 mm., depth of single valve, 9 mm.

The systematic position of this small species is doubtful, as its shape is unlike either *Modiolus* or *Amygdalum*. The smooth, thin and glassy shell and the very weak ligament bring it closer to *Amygdalum* in which it is provisionally included, though further material and study may necessitate a new genus for its reception.

Amygdalum glaberrimum (Dunker).

(Figs. 44, 45.)

Volsella glaberrima Dunker, 1857, Proc. Zool. Soc. Lond., 1856, p. 363.

Modiola glaberrima Reeve, 1857, Conch. Icon. 10, pl. 8, fig. 48.

The type-locality is "Australian seas near the city of Sydney," and its range to date has not been extended far beyond this area. It is in fact difficult to obtain material, as its habitat is apparently among reefs in deeper water where it may live in colonies. The specimen illustrated was dredged in Pittwater, its height from the umbo to the posterior ventral margin 19 mm. This is only about half grown, as specimens in the Australian Museum from Port Jackson are about twice the size, though otherwise identical. It is an easy species to recognise. Compared with *beddomei* it has a different shape, and the fine radial rays at the posterior end are distinctive.

Genus FLUVIOLANATUS Iredale

Fluviolanatus Iredale, 1924, Proc. Linn. Soc. N. S. Wales, 49, p. 196. Type-species, *Modiolarca subtorta* Dunker.

The type has at different times been placed in *Modiolarca*. *Modiolus* and *Musculus*. in any of which it is equally out of place. The main generic characters are the irregular, subquadrangular, inequilateral shell, which is slightly twisted and has a slight posterior gape. The valves also are slightly unequal, the right valve overlapping and clasping the left. The hinge is edentulous, the ligament internal, short, behind the umbo, and set in a narrow submarginal groove. The adductor impressions are faintly impressed, the anterior rather larger and farther from the umbo than in most of the family, the posterior impression very large. The sculpture is confined to irregular growth-lines, and there is no radial sculpture as in *Musculus*. It is an inhabitant of coastal lagoons and brackish water.

Fluviolanatus amarus, sp. nov.
(Figs. 46-49.)

Shell small, nearly rectangular in shape, inequivalved, the right valve slightly larger and clasping the left valve, very inequilateral with a slight median twist, the valves gaping posteriorly, umbos large and flat, terminal but not overhanging. Texture thin and rather chalky, colour yellow, sometimes slightly variegated, but generally hidden by the thin deep yellow-brown periostracum which is roughened at the posterior end. Dorsal margin slightly arched, ventral margin parallel and slightly excavate, anterior margin rounded, posterior margin obliquely truncate. Hingeline arched, thin, edentulous, ligament weak, set in a very narrow submarginal groove. Adductor muscle-scars faintly impressed, the posterior scar very large. Length of type (fig. 46) 12.5 mm., depth of conjoined valves 5.5 mm.

Habitat.—On reedy margins of coastal lagoons of New South Wales, often in water which is nearly fresh. Woolgoolga, holotype and many paratypes; Dee Why Lagoon near Sydney (fig. 48), etc.

Remarks.—This is the species appearing on the New South Wales list as *Musculus subtortus* (Dunker), and recorded from New South Wales by Angas (1867). *Modiolarca subtorta* was described by Dunker in 1857* and figured by Reeve in 1858.† The type-locality is New Holland, north coast, which is almost certainly Port Essington, in the Northern Territory, as this was the only north Australian locality at the time from which Dunker obtained material. Both the description and the figure show this to be quite a different species from *amarus* though evidently they are congeneric. The main difference is in the shape, *subtortus* being narrow anteriorly, whereas *amarus* has the dorsal and ventral margins parallel. This is a constant character even though *amarus* varies slightly its proportions, some specimens being relatively wider. Specimens from New Caledonia which have been labelled *subtortus* are of still another species which is as yet undescribed. These have much the same shape as *amarus* but have radial rays and a radial fold at the posterior end.

Genus EXOSIPERNA Iredale.

Iredale, 1929, Rec. Aust. Mus. 17, p. 166. Type-species, *Arcoperna scapha* Verco.

A genus known only so far from deep water. The shell is small, oval in shape, the umbos terminal, the hinge without true teeth, but with fine crenulations simulating teeth, most prominent on both the post-dorsal and anterior dorsal margins, the ligament weak and obscure, Cotton and Godfrey (1938, p. 120) stating that it appears to be external. The sculpture is both finely radial and concentric, producing a reticulated surface. It is probably related to *Musculus* and *Trichomusculus*, but it has quite a different shape, and the radial sculpture covers the whole of the shell and is not discrepant as in both those genera.

Exosiperna relata Iredale.
(Figs. 50-51.)

Exosiperna relata Iredale, 1929, Rec. Aust. Mus. 17, p. 167.

This is the species included in Hedley's check-list (1917, No. 96) as *Musculus scapha* Verco. Iredale based his species on material in the Australian Museum from 80 fms. off Narrabeen labelled *scapha* and obviously the source of Hedley's record, though it does not appear in the list of species in Hedley's own paper on the mollusca from that locality. The species has not so far been figured and the material is not of the best. The illustration now given is of the specimen in the Australian Museum, No. C.26032; this is presumably the type. It is very close to the South Australian *scapha*, but differs slightly in shape and details of the hinge. Its height is 5.5 mm. and the depth of the single valve approximately 2.5 mm.

* Proc. Zool. Soc. Lond., 1856 (1857), p. 365.
† Conch. Icon., 1858, 10, pl. 10, fig. 57.

Genus SOLAMEN Iredale.

Solamen Iredale, 1924, Proc. Linn. Soc. N. S. Wales 49, p. 198. Type-species, *Solamen rex* Iredale.

Shell oval, inflated, with large umbos, very thin and fragile, the hinge quite edentulous and without crenulations, the ligament weak, semi-internal, the submarginal ligamental groove very narrow and barely discernible. Sculpture of very fine, closely packed radial threads.

Solamen rex Iredale.

(Figs. 52-53.)

Solamen rex Iredale, 1924, Proc. Linn. Soc. N. S. Wales 49, p. 198, pl. 33, fig. 15, pl. 35, fig. 2.

This is probably the species recorded by Hedley* as *Arcoperna recens* Tate from 8 fms., Port Stephens, where it was procured alive encased in a nodule of hard mud. In his check-list (1917, No. 95) Hedley placed it under *Musculus*. The type of *rex* came from Twofold Bay, and the specimen illustrated is of a still larger specimen in the Australian Museum from 55 fms., off Green Cape. Its height is 29 mm. and depth of conjoined valves 24 mm. It is very close to the Tasmanian and South Australian *recens*, but differs slightly in shape.

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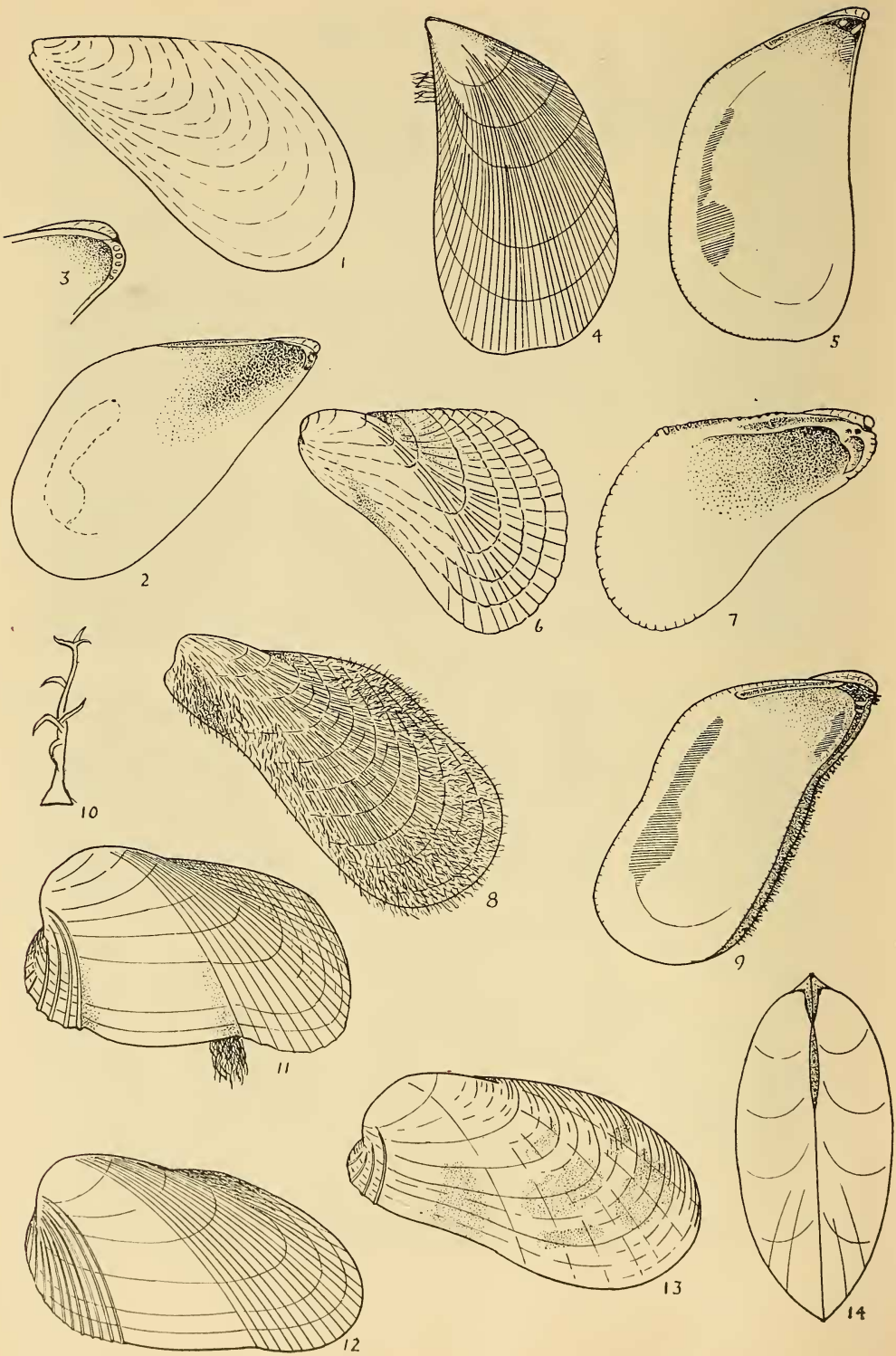
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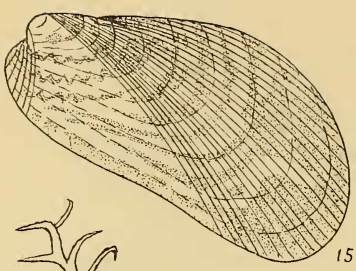
EXPLANATION OF FIGURES.

Fig.

1. *Mytilus planulatus* Lamarck, left valve.
2. *Mytilus planulatus* Lamarck, interior.
3. *Mytilus planulatus* Lamarck, hinge.
4. *Austromytilus rostratus* (Dunker), left valve.
5. *Austromytilus rostratus* (Dunker) interior.
6. *Septifer australis*, sp. nov., holotype, left valve.
7. *Septifer australis*, sp. nov., interior.
8. *Trichomya hirsuta* (Lamarck), left valve.
9. *Trichomya hirsuta* (Lamarck), interior.
10. *Trichomya hirsuta* (Lamarck), hair magnified.
11. *Musculus cumingianus* (Reeve), left valve,
12. *Musculus ulmus* Iredale, left valve.
13. *Musculus alganus*, sp. nov., holotype, left valve.
14. *Musculus alganus*, sp. nov., conjoined valves.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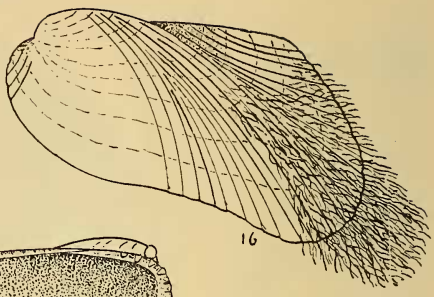
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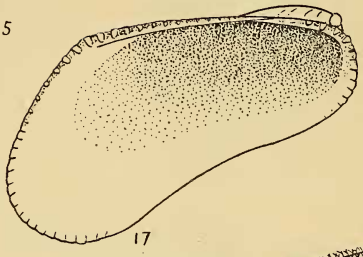
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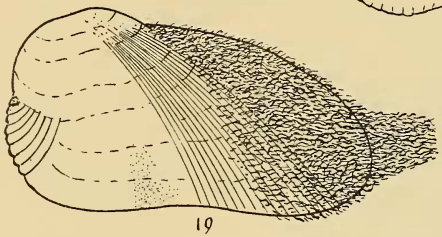
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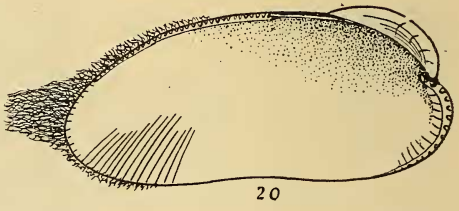
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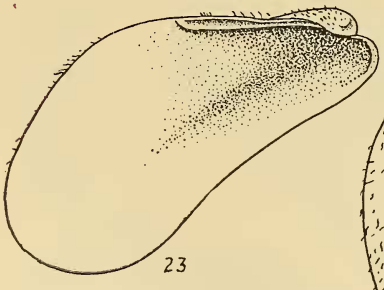
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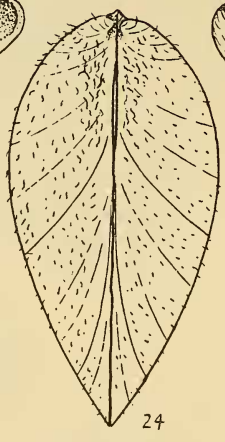
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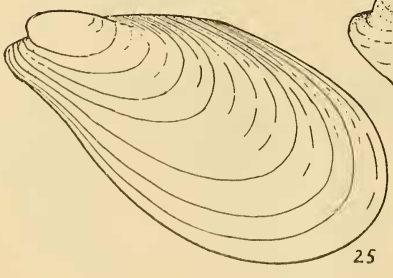
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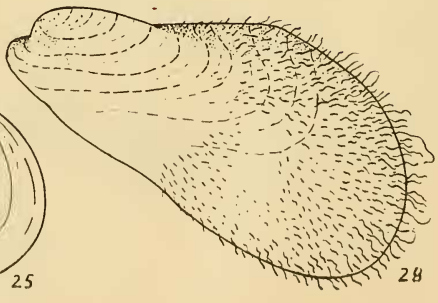
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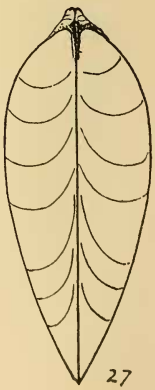
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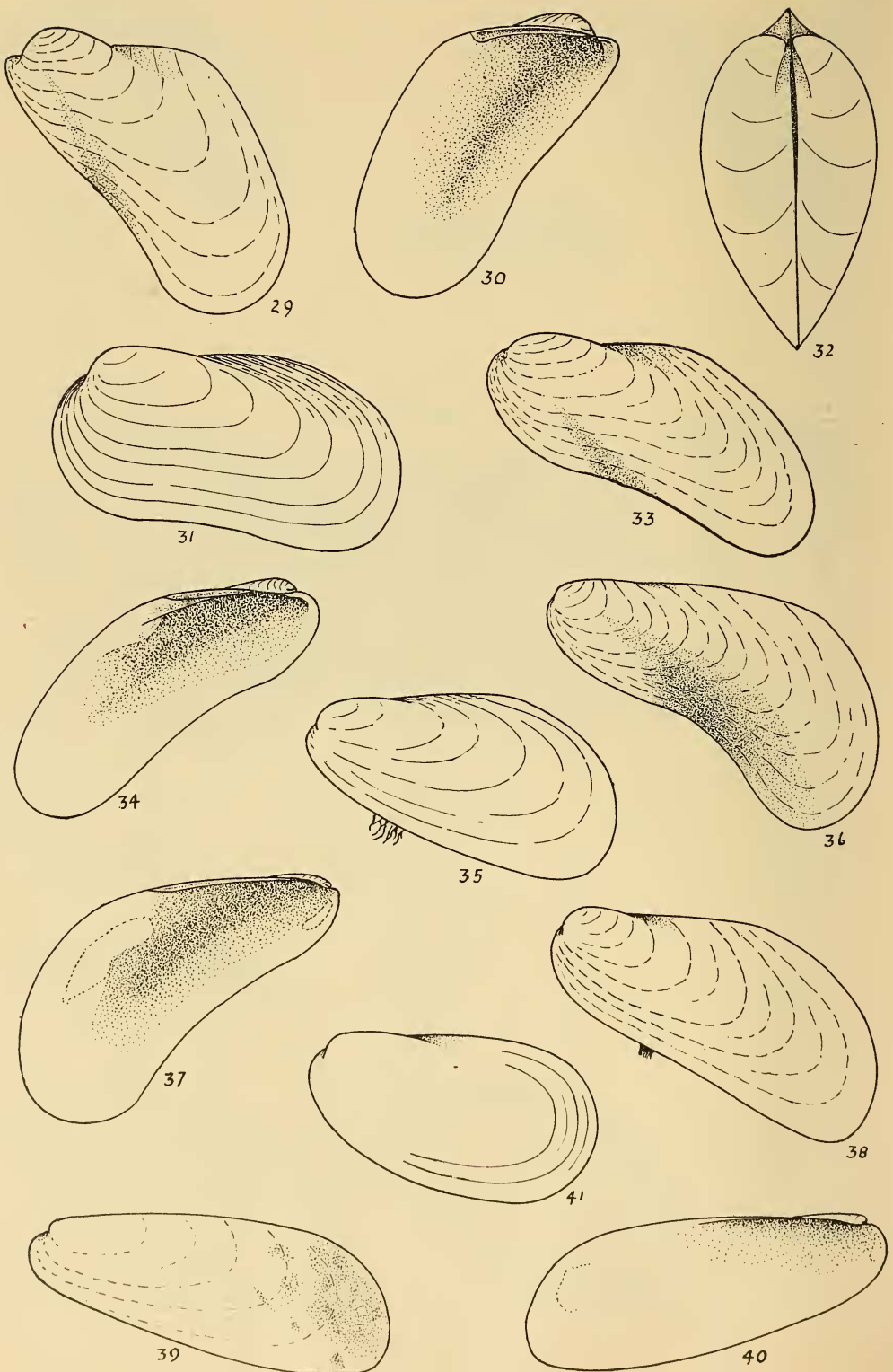
EXPLANATION OF FIGURES.

Fig.

15. *Musculus varicosus* (Gould), left valve.
16. *Trichomusculus barbatus* (Reeve), left valve.
17. *Trichomusculus barbatus* (Reeve), interior.
18. *Trichomusculus barbatus* (Reeve), hair magnified.
19. *Trichomusculus splendidus* (Dunker), left valve.
20. *Trichomusculus splendidus* (Dunker), interior.
21. *Trichomusculus splendidus* (Dunker), hair magnified.
22. *Modiolus peronianus*, sp. nov., holotype, left valve.
23. *Modiolus peronianus*, sp. nov., interior.
24. *Modiolus peronianus*, sp. nov., conjoined valves.
25. *Modiolus cottoni*, sp. nov., holotype, left valve.
26. *Modiolus cottoni*, sp. nov., hinge.
27. *Modiolus cottoni*, sp. nov., conjoined valves.
28. *Modiolus cottoni*, sp. nov., juvenile with periostracum.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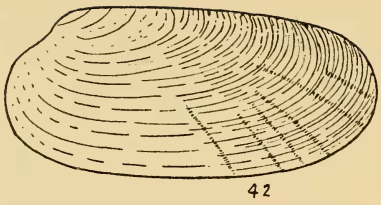
EXPLANATION OF FIGURES.

Fig.

29. *Modiolus agripeta* Iredale, left valve.
30. *Modiolus agripeta* Iredale, interior.
31. *Modiolus victoriae* Pritchard & Gatliff, left valve.
32. *Modiolus victoriae* Pritchard & Gatliff, conjoined valves.
33. *Modiolus deliniificus* Iredale, left valve.
34. *Modiolus delinificus* Iredale, interior.
35. *Modiolus delinificus* (?) Iredale, juvenile.
36. *Modiolus pulex* (Lamarck), left valve.
37. *Modiolus pulex* (Lamarck), interior.
38. *Modiolus pulex* (Lamarck), another specimen.
39. *Amygdalum beddomei* Iredale, left valve.
30. *Amygdalum beddomei* Iredale, interior.
41. *Amygdalum beddomei* Iredale, juvenile.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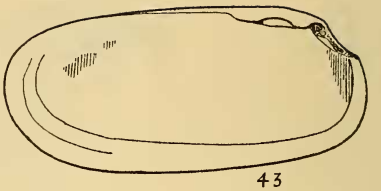
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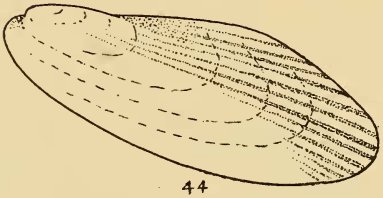
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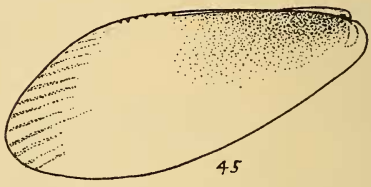
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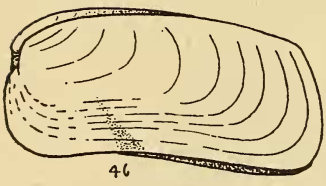
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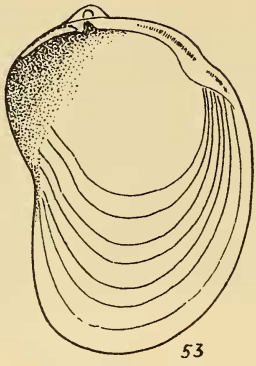
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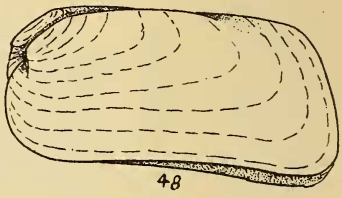
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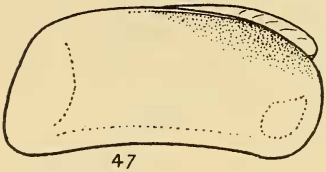
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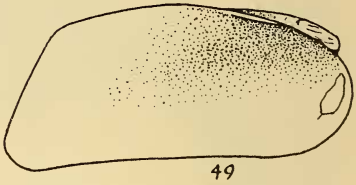
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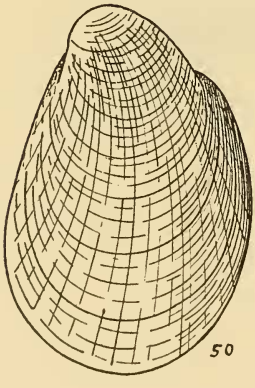
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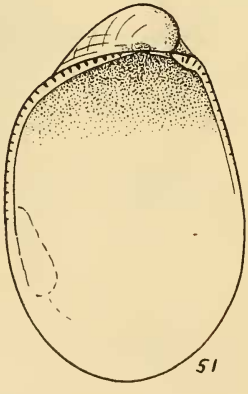
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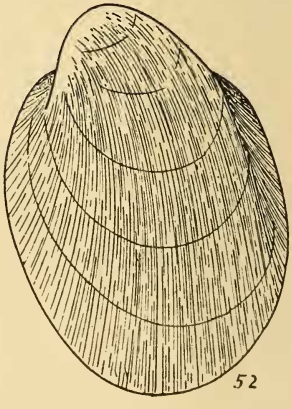
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EXPLANATION OF FIGURES.

Fig.

42. *Amygdalum lineum* (Hedley), after Hedley, left valve.
43. *Amygdalum lineum* (Hedley), after Hedley, interior.
44. *Amygdalum glaberrimum* (Dunker), left valve.
45. *Amygdalum glaberrimum* (Dunker), interior.
46. *Fluviolanatus amarus*, sp. nov., holotype, left valve.
47 *Fluviolanatus amarus*, sp. nov., holotype, interior.
48 *Fluviolantus amarus*, sp. nov., another specimen.
49. *Fluviolanatus amarus*, sp. nov., another specimen, interior.
50. *Exosiperna relata* Iredale, left valve.
51. *Exosiperna relata* Iredale, interior.
52. *Solamen rex* Iredale, left valve.
53. *Solamen rex* Iredale, interior.